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## (54) FORMATION OF LEAD-ACID BATTERY PLATES


(71) We, LUCAS INDUSTRIES LIMITED, of Great King Street, Birmingham, B19 2XF, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—


This invention relates to the formation of lead-acid battery plates.

The formation of lead-acid battery plates involves immersing battery plate grids carrying the required lead-acid battery paste in an aqueous solution of sulphuric acid and then passing an electric current between the grids so as to convert the paste on the grids to the active material of the plates and subsequently charge the plates. In one known method of performing this operation, the grids and the acid are introduced into the battery box which is to define the container of the finished battery and box is sealed with a battery lid, prior to the passage of the electric current. This method is particularly suited to the production of drained, charged batteries, that is batteries which are drained after forming and then stored with their plates in a moist condition until they are subsequently activated for service. However, this known method suffers from the problem that gases are generated during formation and these can result in the escape of acid, either as an acid-laden mist or as acid bubbles, through the filling and venting apertures in the lid. This problem is especially pronounded if the forming operation is performed at high temperatures or high current to decrease the formation time. It is therefore an object of the present invention to alleviate and/or minimise this problem.

Accordingly, the invention resides in one aspect in a method of forming battery plates for a lead-acid battery, comprising the steps of assembling at least one pack of battery plate grids and separators into a battery box closed by a lid having at least one filling and venting aperture, said at least one pack including a plurality of grids having insulating separators interposed therebetween with each pair of adjacent grids carrying the lead-acid battery paste required to produce a negative battery plate and a positive battery plate respectively; filling the battery box with an aqueous solution of sulphuric acid; inserting into said filling and venting aperture one end of of a hollow body which is formed at said one end with at least one opening connecting the interior of the battery box to the bore in the body; and then passing an electric current through the grids so as to convert said paste to the active material of the plates and thereafter charge the plates, gases generated by the passage of electric current flowing through said opening and along the bore in the body over baffle means provided in the body and escaping through an aperture in a closure member at the other end of the body, acid entrained in said gases being removed by said baffle means and returning to the battery box by way of said opening.

Preferably, said at least one opening in the body is defined by a longitudinally extending slot formed in the side wall of the body at said one end thereof and/or by a hole in said one axial end of the body.

Preferably, said closure member is formed separately from the body and is removable from the body.

Conveniently, said baffle means is defined at least in part by a portion of said closure member extending into said bore.

Preferably, the battery box is divided into a plurality of cell compartments in each of which a respective pack of grids and separators is assembled, the lid includes a plurality of filling and venting apertures communicating with the cell compartments respectively, said body forms part of a venting device including at least one further identical body which is inserted at said one end in a respective filling and venting aperture, said bodies being joined together so that their longitudinal axes extend, substantially parallel, and a common removable lid closes the other end of the body.

Preferably, the passage of electric current is performed at a temperature of at least 150°F and is conducted in two stages separated by a standing period of at least 30 minutes.

In the accompanying drawings:

Figures 1 and 2 are sectional views respectively of part of a device according to one example of the invention, and

Figure 3 is a sectional view of the closure member of the device of said one example.

Referring to the drawings, the device includes three hollow, generally tubular bodies 11 joined by integral webs 12 so that the longitudinal axes of the bodies 11 are parallel. Each body 11 tapers inwardly towards one end 13 and at its opposite end 14 opens into an enlarged portion 15. The portions 15 together define a common, open trough 16 which is divided by partition walls 17 extending between adjacent pairs respectively of the portions 15. Formed in each partition 17 is a central groove 18 and a pair of outer grooves 19 located at opposite sides respectively of the trough 16.

Adjacent the end 13, each body 11 is stepped inwardly to define a tapered narrow portion 21 which at its free end is partially closed by an integral end wall 22. Formed in each end wall 22 is a centrally disposed hole 23 which communicates with the elongated bore 25 defined by the respective tubular body 11. Moreover, formed in diametrically opposite regions of each portion 21 are respective slots 24 which extend longitudinally from the respective end wall 23 and also communicate with the associated bore 25.

As shown in Figure 3, the device also includes a cover 26 which, in use, is detachably engaged with the trough 16 to define a common closure member for the bodies 11. The cover 26 includes an external wall 27 extending around an internal skirt 28 arranged so that, in use, the outer wall of the trough 16 is received as a tight fit between the wall 27 and skirt 28 to aid retention of the cover 26 on the trough 16. Depending from the cover 26 are three tubular projections 29 each of which extends below the wall 27 and is divided along the majority of its length by a pair of diametrically opposite grooves 31 (only one shown). When the cover 26 is engaged with the trough 16, the projections 29 extend into respective portions 14 of the bodies 11 to define with the partition wall 17 baffle means for the gases which, in use, pass through the bores 25. The cover 26 is also formed with a pair of venting apertures 32 located between the pair of venting apertures 32 located between the pairs respectively of adjacent projections 29.

The device described above is intended to assist in the formation of battery plates in situ, that is where the formation occurs in the battery box which is to accommodate the formed battery plates. In such a method, pasted battery plate grids are first assemblied into packs with separators being interposed between the grids and with each pair of adjacent grids carrying the paste required to produce a negative battery plate and a positive battery plate respectively. The packs are then positioned in the cell compartments defined within the battery box and the required intercell connections are completed through the partition walls dividing the box into the cell compartments. The cell compartments are then filled with an aqueous solution of sulphuric acid before or after which a battery lid is welded to the open end of the box, the lid being formed in conventional manner with filling and venting apertures communicating with the cell compartments respectively. The device described is then engaged with the lid by inserting each portion 21 into a respective filling and venting aperture in the lid, it being appreciated that for a normal six cell battery, two such devices will be necessary. The taper on each portion 21 is arranged so that, when engaged with the lid, only the free end of the portion 21 extends through the respective filling and venting aperture into the associated cell compartment of the battery box. Thus each cell compartment not only then communicates with a respective bore 25 by way of the hole 23 and slot 24 in the associated body 11, but also is vented to atmosphere by way of the slot 24.

When the or each device is engaged with the lid, an electric current is passed between the grids in the battery box so as to convert the paste on the grids into the required active material of the plates, and subsequently charge the plates. Preferably, the passage of the electric current is performed in two stages separate by a period of standing of at least 30 minutes, the first stage being terminated when the charge on the plates is at least 50%, or more preferably at least 90% of the required final value.

During passage of the electric current, gases are evolved which cause the acid solution to bubble vigorously especially if the forming temperature is allowed to rise towards the upper end of the preferred forming temperature range of 150°F to 200°F. These gases are heavily laden with sulphuric acid, but before being vented to atmosphere through the apertures 32, must flow through the holes 23 and slots 24, along the bores 25 and over the partition walls 17 and projections 29. Thus a large proportion of the acid is removed prior to the gases venting to atmosphere, particularly at the baffle means defined by the partition walls 17 and projections 29, the

acid thereby collected then flowing down the down the tubes 11 back into the battery box.

Where the forming operation is performed at high temperatures, the bubbling of the acid solution can become so severe as to cover the end walls 23 of the tubes 11, but in this case the bores 25 are still vented to atmosphere through the slots 24 so reducing the tendency for the acid to be drawn up the tubes 11. If, however, the bubbling increases further so as to cover the entire length of the slots 24, it will be seen that the length of the tubes 11 is sufficient to accomodate a relatively large amount of acid rise before the acid overflows through the apertures 32.

Thus the device described above enables battery plates to be formed in situ at a relatively high temperature, that is between 150° - 200°F, without danger to the operating personnel and without excessive electrolyte loss. Moreover, the use of the device described prevents particles of carbon black, which tend to be picked up by the acid vapour from the negative plates, being deposited on the external walls of the battery. In this way it is possible to avoid the detergent washing step normally necessary with prior art forming techniques to remove the carbon black deposits which would otherwise give the battery an unsightly external appearance.

In a modification of the device described above, the interior of each body 11 is filled with an acid resistant fibrous packing, such as p.v.c. wool, which provides an increased surface area within the body for contact with the acid vapours and hence improve the acid condensing properties of the device. As an alternative, a similar advantageous effect can be achieved by providing a set of baffles in each tubular body 11. In this case, each set of baffles is conveniently in the form of a plurality of semi-circular plates spaced along the length of an elongated carrier so that adjacent plates extend perpendicular to, but in opposite directions respectively from a plain containing the longitudinal axis of the carrier and the diameter of each plate. Each carrier is conveniently arranged to locate in one of the projections 29 formed on the underside of the cover 26 so that, in use, the longitudinal axis of the carrier is co-extensive with the axis of the associated body 11. Moreover, the diameters of baffle plates are preferably arranged to vary in accordance with the taper on their associated body 11 so that each plate engages the internal wall of the body and, in use, the acid vapours are constrained by the plates to flow along a spiral path through the body.

It is to be appreciated that the interconnected bodies 11 and the cover 26 will normally be moulded in an acid resistant thermoplastic material, such as polypropylene.

WHAT WE CLAIM IS:—

1. A method of forming battery plates for a lead-acid battery, comprising the steps of assembling at least one pack of battery plate grids and separators into a battery box closed by a lid having at least one filling and venting aperture, said at least one pack including a plurality of grids having insulating separators interposed therebetween with each pair of adjacent grids carrying the lead-acid battery paste required to produce a negative battery plate and a positive battery plate respectively; filling the battery box with an aqueous solution of sulphuric acid; inserting into said filling and venting aperture one end of a hollow body which is formed at said one end with least one opening connecting the interior of the battery box to the bore in the body; and then passing an electric current through the grids so as to convert said paste to the active material of the plates and thereafter charge the plates, gases generated by the passage of electric current flowing through said opening and along the bore in the body over baffle means provided in the body and escaping through an aperture in a closure member at the other end of the body, acid entrained in said gases being removed by said baffle means and returning to the battery box by way of said opening.

2. A method as claimed in Claim 1, wherein said at least one opening in the body is defined by a longitudinally extending slot formed in the side wall of the body at said one end thereof and/or by a hole in said one axial end of the body.

3. A method as claimed in Claim 1 or Claim 2, wherein said closure member is formed separately from the body and is removable from the body.

4. A method as claimed in any one of Claims 1 to 3, wherein said baffle means is defined at least in part by a portion of said closure member extending into said bore.

5. A method as claimed in any one of Claims 1 to 3, wherein said baffle means includes an acid-resistant fibrous packing mounted in the bore in the body.

6. A method as claimed in any one of Claims 1 to 3, wherein said baffle means includes a plurality of baffle plates spaced along the length of the bore in the body.

7. A method as claimed in any one of the preceding Claims, wherein the battery box is divided into a plurality of cell compartments in each of which a respective pack of grids and separators is assembled, the lid, includes a plurality of filling and venting apertures communicating with the cell compartments respectively and said body forms part of a venting device in-

cluding at least one further identical body which is inserted at said one end in a respective filling and venting aperture, said bodies being joined together so that their longitudinal axes extend substantially parallel, and a common removable lid closes the other end of the body.

8. A method as claimed in any preceding Claim, wherein the passage of electric current is performed at a temperature of at least 150°F and is conducted in two stages separated by a standing period of at least 30 minutes.

9. A method as claimed in Claim 1, of forming battery plates for a lead-acid battery substantially as hereinbefore described.

10. A lead-acid battery having battery plates formed by a method as claimed in any preceding Claim.

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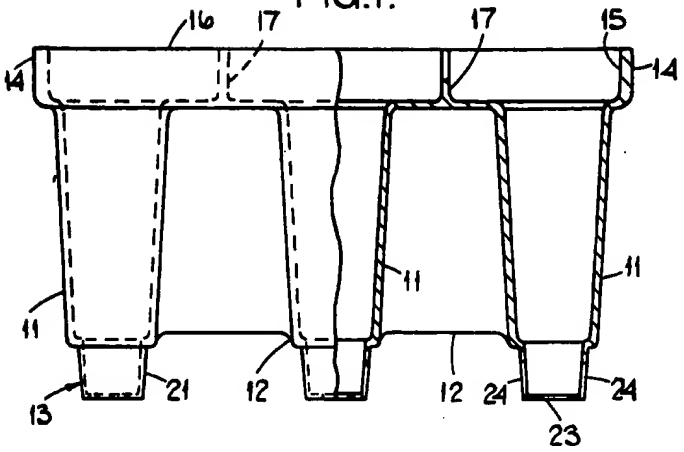
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG.1.



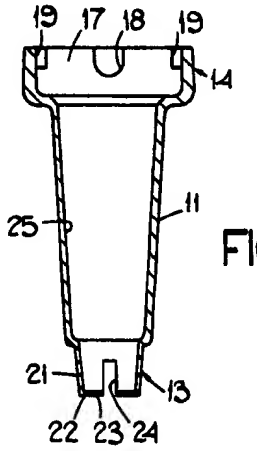




FIG.2.

FIG.3.